WHAT IS CLAIMED IS:

- 1. An electrolyte solution having a Tg of less than about -40°C, comprising at least one bifunctional redox dye dissolved in ionic liquid solvent.
- 2. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises at least one redox active anodic moiety and at least one redox active cathodic moiety.
- 3. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises at least one energy receptor moiety and at least one redox active anodic moiety, at least one energy receptor moiety and at least one redox active cathodic moiety, or at least one energy receptor moiety and at least one redox active anodic moiety and at least one redox active cathodic moiety.
- 4. The electrolyte solution of claim 1, wherein said ionic liquid solvent comprises at least one cation selected from the group consisting of lithium cation and quaternary ammonium cations, wherein said quaternary ammonium cations are selected from the group consisting of pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium,
- pyrazolium, thiazolium, oxazolium, triazolium, tetraalkylammonium, N-methyl morpholinium, cations of the formula $[(CH_3CH_2)_3N(R_1)]^+$, wherein R_1 is alkyl having 2-10 carbons, cations of the formula $[(CH_3)_2(CH_3CHCH_3)N(R_2)]^+$, wherein R_2 is alkyl having 2-10 carbons, cations having the structural formula

wherein R₃ is alkyl having 2-10 carbons, and cations having the structural formula

$$CH_3$$
 N
 N^{\dagger}
 R_4

wherein R₄ is alkyl having 2-10 carbons.

- 5. The electrolyte solution of claim 1, wherein said ionic liquid comprises at least one anion selected from the group consisting of trifluoromethylsulfonate (CF₃SO₃⁻), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻).
- 6. The electrolyte solution of claim 2, wherein said anodic moiety of said bifunctional redox dye comprises a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene or phenazine, and said cathodic moiety of said bifunctional redox dye comprises a viologen or anthraquinone.
- 7. The electrolyte solution of claim 1, wherein said bifunctional redox dye is a compound having the structural formula

$$(R_{10})m$$
 Me
 $R_{12}-N^{+}$
 R_{13}
 Me
 $R_{11})n$
 $R_{12}-N^{+}$
 R_{13}
 $R_{12}-R_{13}$
 R_{11}
 $R_{12}-R_{13}$
 $R_{13}-R_{13}$
 $R_{14}-R_{13}$
 $R_{15}-R_{15}$
 $R_$

$$R_{10}$$
 Me R_{12} N^{+} R_{14} R_{14} R_{14} R_{14} R_{14}

or having the structural formula

5

$$(R_{10})m$$
 Me
 A
 B
 $(R_{11})n$
 R_{12}
 R_{13}
 $(R_{10})m$
 R_{12}
 R_{13}
 $(R_{10})m$
 R_{13}
 $(R_{11})n$
 R_{12}
 $(R_{11})n$

$$R_{10}$$
 R_{12} R_{14} R_{14} R_{11} R_{12} R_{14} R_{14} R_{14} R_{14} R_{14} R_{15} R_{16} R_{17} R_{18} R_{19} R

wherein A is selected from the group consisting of trifluoromethylsulfonate (CF₃SO₃), 10 bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻); B⁻ is selected from the group consisting of a halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and 15 tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C^{*}); wherein R₁₀ and R₁₁ are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where R_{10} or R_{11} is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein m=0-4; wherein n=0-4; wherein R₁₂ and R₁₃ are each independently a hydrocarbon residue 20 having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and R₁₄ is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or 25 heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or heterocyclic group with a substituent group; and Me represents Cr. Co, Fe, Mn, Ni, Os, Ru, V, Mo(X)(Q), Nb(X)(Q), Ti(X)(Q), V(X)(Q) or Zr(X)(Q) wherein X and Q are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, CH₃(C₆H₄)SO₃, 30 trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻);

or having the formula

 Cat_1-An_1

or having the formula

Cat₁-Bridge₁-An₁

or having the formula

Cat₁-Bridge₁-An₁-Bridge₂-Cat₂,

40 or having the formula

An₂-Bridge₂-Cat₁-Bridge₁-An₁,

wherein Cat₁-An₁ represents a charge transfer complex;

wherein Cat₁ and Cat₂ independently represent a radical having the structural formula

$$R_{30}$$
 R_{26}
 R_{27}
 R_{31}
 R_{17}
 R_{18}
 R_{28}
 R_{29}
 R_{32}

or having the structural formula

or having the structural formula

or having the structural formula

$$C^{-}$$
 R_{20}
 R_{17}
 R_{18}
 R_{27}
 R_{19}
 R_{21}
 R_{31}

or having the structural formula

or having the structural formula

60

65

wherein R_{17} and R_{18} independently of one another denote C_1 to C_{18} -alkyl, C_2 to C_{12} -alkenyl, C_3 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl or R_{17} and R_{18} together form a -(CH_2)₂-, -(CH_2)₃-, or -CH=CH- bridge, R_{19} , R_{20} and R_{22} to R_{25} independently of one another denote hydrogen, C_1 to C_{18} -alkyl, C_1 to C_4 -alkoxy, halogen, cyano, nitro or C_1 to C_{18} -alkoxycarbonyl or R_{22} and R_{23} and/or R_{24} and R_{25} form a -CH=CH-CH=CH-bridge; R_{26} , R_{27} , R_{28} and R_{29} independently of one another denote hydrogen or, in pairs, a -(CH_2)₂-, -(CH_2)₃- or -CH=CH- bridge, E_3 and E_4 independently of one another denote O, N-CN, $C(CN)_2$ or N- C_6 - to C_{10} -aryl, R_{34} and R_{35} independently denote hydrogen, C_1 to C_{18} -alkyl, C_1 to C_{18} -alkoxy, halogen, cyano, nitro, C_1 to C_{18} -alkoxycarbonyl or C_6 to C_{10} -

aryl, R₃₀ to R₃₃ independently of one another denote hydrogen or C₁ to C₆ -alkyl, or R₃₀ and R₂₆ and/or R₃₁ and R₂₇ form a -CH=CH-CH=CH- bridge, E₁ and E₂ independently of one another denote O, S, NR₃₆ or C(R₃₆)₂ or E₁ and E₂ together form a -N-(CH₂)₂-N-70 bridge, R₃₆ denotes C₁ to C₁₈ -alkyl, C₂ to C₁₂ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ aralkyl or C_6 to C_{10} -aryl, Z_1 denotes a direct bond, -CH=CH-, -C(CH₃)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N- $N=C(CH_3)$ - or $-CCl=N-N=CCl_{-}$, Z_2 denotes $-(CH_2)_{r-}$ or $-CH_2-C_6H_4-CH_2-$, r=1-10, C is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), 75 bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C^{*}), and D^{*} is selected from the group consisting of halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and 80 tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C'), wherein bonding to the bridge member bridge₁ or bridge₂ is effected via one of the radicals R₁₇-R₃₆, and the radicals mentioned then represent a direct bond,

and wherein An_1 and An_2 independently represent radicals having the structural formula:

or having the structural formula

85

or having the structural formula

or having the structural formula

95 or having the structural formula

or having the structural formula

$$R_{44}$$
 E_{5} E_{7} R_{46} R_{45} E_{6} E_{8} R_{45}

$$R_{44}$$
 R_{45}
 R_{46}
 R_{43}

or having the structural formula

or having the structural formula

105

110

115

or wherein An₁ or An₂ independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein R₃₇ to R₄₃ independently of one another denote C₁ to C₁₈ - alkyl, C₂ to C₁₂ -alkenyl, C₃ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl, and R₄₁ to R₄₃ additionally denote hydrogen, R₄₄ to R₅₀ independently of one another denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₁₈ -alkoxy, halogen, cyano, nitro, C₁ to C₁₈ - alkoxycarbonyl or C₆ to C₁₀ -aryl and R₄₈ and R₄₉ additionally denote an optionally benzofused aromatic or quasiaromatic five- or six-membered heterocyclic ring and R₅₀ additionally independently denotes N(R₅₁)(R₅₂), R₄₄ and R₄₅ and/or R₄₆ and R₄₇ form a - (CH₂)₃-, -(CH₂)₄-, -(CH₂)₅- or -CH=CH-CH=CH- bridge, Z₃ denotes a direct bond or a - CH=CH- or -N=N- bridge, =Z₄= denotes a direct double bond or a =CH-CH= or =N-N=

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130

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bridge, E_3 and E_4 independently of one another denote O, S, NR₅₁, C(R₅₁)(R₅₂), C=O or SO₂, E_5 to E_8 independently of one another denote S, Se or NR₅₁, R₅₁ and R₅₂ independently of one another denote C₁ to C₁₂ -alkyl, C₂ to C₈ -alkenyl, C₃ to C₇ - cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl, R₅₃ to R₆₀ independently of one another denote hydrogen, C₁ - to C₆ -alkyl, C₁ to C₁₈ -alkoxy, cyano, C₁ to C₁₈ -alkoxycarbonyl or C₆ to C₁₀ -aryl, or R₅₃ and R₅₄ and R₅₉ and R₆₀ independently of one another together form a -(CH₂)₃-, -(CH₂)₄- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge member Bridge₁ or Bridge₂ is effected by one of the radicals R₃₇ -R₅₄, or R₆₀ and the radicals mentioned then represent a direct bond, and Bridge₁ or Bridge₂ independently represents a bridge member of the formula -(CH₂)_n- or -(Y₁)₈(CH₂)_m-(Y₂)_o-(CH₂)_p-(Y₃)_q-, each of which is optionally substituted by C₁ to C₁₈ -alkoxy, halogen or phenyl, Y₁ to Y₃ independently of one another independently represent O, S, NR₆₁, COO, CONH, NHCONH, cyclopentanediyl, cyclohexanediyl, phenylene or naphthylene, beta-dicarbonyls, R₆₁ denotes C₁ to C₆ -alkyl, C₂ to C₆ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ - to C₁₀ -aryl, n=0-12, m=0-8, p=0-12, o=0-6, q=0-1, and s=0-1.

- 8. The electrolyte solution of claim 3, wherein said bifunctional redox dye comprises a redox active moiety comprising a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene, phenazine, viologen or anthraquinone, and an energy receptor moiety comprising a benzophenone, benzotraizole, or cyanoacrylate.
- 9. The electrolyte solution of claim 1, wherein said bifunctional redox dye comprises a compound having the formula

$[Cat_1][M]$

wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II); wherein Cat₁ represents a ligand having the structural formula

$$R_{17}$$
 R_{17}
 R_{18}
 R_{17}
 R_{18}
 R_{28}
 R_{29}
 R_{32}

or having the structural formula

$$R_{19} = \begin{bmatrix} E_1 & E_2 & E_2 \\ & & & & \\ & & &$$

or having the structural formula

$$R_{26}$$
 R_{27}
 R_{47}
 R_{49}
 R_{49}
 R_{41}
 R_{49}
 R_{41}

15

or having the structural formula

or having the structural formula

20

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35

40

or having the structural formula

wherein R_{17} and R_{18} independently of one another denote C_1 to C_{18} -alkyl, C_2 to C_{12} alkenyl, C₃ to C₇-cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl or R₁₇ and R₁₈ together form a -(CH₂)₂-, -(CH₂)₃-, or -CH=CH-, R_{19} , R_{20} and R_{22} to R_{25} independently of one another denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₁₈ -alkoxy, halogen, cyano, nitro or C₁ to C₁₈ -alkoxycarbonyl or R₂₂ and R₂₃ and/or R₂₄ and R₂₅ form a –CH=CH-CH=CH- bridge; R₂₆, R₂₇, R₂₈ and R₂₉ independently of one another denote hydrogen or, in pairs, a -(CH₂)₂-, -(CH₂)₃- or -CH=CH- bridge, E₃ and E₄ independently of one another denote O, N-CN, C(CN)₂ or N-C₆ - to C₁₀-aryl, R₃₄ and R₃₅ independently denote hydrogen, C₁ to C₁₈ -alkyl, C1 to C18 -alkoxy, halogen, cyano, nitro, C1 to C18 -alkoxycarbonyl or C6 to C10 aryl, R₃₀ to R₃₃ independently of one another denote hydrogen or C₁ -C₆ -alkyl, or R₃₀ and R₂₆ and/or R₃₁ and R₂₇ form a -CH=CH-CH=CH- bridge, E₁ and E₂ independently of one another denote O, S, NR_{36} or $C(R_{36})_2$ or E_1 and E_2 together form a -N-(CH_2)₂-N- bridge, R₃₆ denotes C₁ to C₁₈ -alkyl, C₂ to C₁₂ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C_6 to C_{10} -aryl, Z_1 denotes a direct bond, -CH=CH-, -C(CH₃)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N-N=C(CH₃)- or -CCl=N-N=CCl-, Z_2 denotes -(CH₂)_r- or -CH₂-C₆H₄-CH₂-, r=1-10, C is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C'), and D' is selected from the group

5

consisting of halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C).

- 10. The electrolyte solution claim 1, further comprising at least one additive selected from the group consisting of non-ionic cosolvents, polymers, thixotropic agents, and UV stabilizers.
- 11. An electro-optic device comprising at least one chamber and, as the electrolyte medium inside the chamber, an electrolyte solution having a Tg of less than about -40°C and comprising at least one bifunctional redox dye dissolved in an ionic liquid solvent.
- 12. The electro-optic device of claim 11, wherein said bifunctional redox dye comprises at least one redox active anodic moiety and at least one redox active cathodic moiety.
- 13. The electro-optic device of claim 11, wherein said bifunctional redox dye comprises at least one energy receptor moiety and at least one redox active anodic moiety, at least one energy receptor moiety and at least one redox active cathodic moiety, or at least one energy receptor moiety and at least one redox active anodic moiety and at least one redox active cathodic moiety.
- 14. The electro-optic device of claim 11, wherein said ionic liquid comprises at least one cation selected from the group consisting of lithium cation and quaternary ammonium cations, wherein said quaternary ammonium cations are selected from the group consisting of pyridinium, pyridazinium, pyrimidinium, pyrazinium, imidazolium, pyrazolium,
- thiazolium, oxazolium, triazolium, tetraalkylammonium, N-methyl morpholinium, cations of the formula [(CH₃CH₂)₃N(R₁)]⁺, wherein R₁ is alkyl having 2-10 carbons, cations of the formula [(CH₃)₂(CH₃CHCH₃)N(R₂)]⁺, wherein R₂ is alkyl having 2-10 carbons, cations having the structural formula

wherein R₃ is alkyl having 2-10 carbons, and cations having the structural formula

$$CH_3$$
 N^{+}
 R_4

wherein R₄ is alkyl having 2-10 carbons.

- 15. The electro-optic device of claim 11, wherein said ionic liquid comprises at least one anion selected from the group consisting of trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C).
- 16. The electro-optic device of claim 12, wherein said anodic moiety of said bifunctional redox dye comprises a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene or phenazine, and said cathodic moiety of said bifunctional redox dye comprises a viologen or anthraquinone.
- 17. The electro-optic device of claim 11, wherein said bifunctional redox dye is a compound having the structural formula

$$(R_{10})$$
 Me R_{12} N^{+} R_{13} Me R_{10} Me R_{11} Me R_{11} Me R_{12} R_{13} R_{14} R_{15} $R_$

or having the structural formula

$$R_{10}$$
)m
 R_{12}
 R_{14}
 R_{14}
 R_{14}

or having the structural formula

5

15

20

25

$$(R_{10})m$$
 $R_{12}-N^{+}$
 R_{13}
 $(R_{10})m$
 $R_{12}-N^{+}$
 R_{13}
 $(R_{10})m$
 $R_{12}-N^{+}$
 R_{13}
 $(R_{11})m$
 $R_{12}-N^{+}$
 R_{13}
 $(R_{11})m$
 $R_{12}-N^{+}$
 R_{13}
 $(R_{11})m$

or having the structural formula

$$R_{10}$$
)m R_{12} N^{+} R_{14} R_{12} N^{+} R_{14} R_{12} R_{12} R_{14} R_{14} R_{15} R_{16} R_{17} R_{18} R_{19} R

wherein A is selected from the group consisting of trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻); B⁻ is selected from the group consisting of a halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃⁻, trifluoromethylsulfonate (CF₃SO₃⁻), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C^{*}); wherein R₁₀ and R₁₁ are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where R_{10} or R_{11} is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein m=0-4; wherein n=0-4; wherein R₁₂ and R₁₃ are each independently a hydrocarbon residue having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and R₁₄ is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or heterocyclic group with a substituent group; and Me represents Cr, Co, Fe, Mn, Ni, Os, Ru,

V, Mo(X)(Q), Nb(X)(Q), Ti(X)(Q), V(X)(Q)or Zr(X)(Q) wherein X and Q are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms, ClO₄⁻, BF₄⁻, PF₆⁻, AsF₆⁻, SbF₆⁻, CH₃COO⁻, CH₃(C₆H₄)SO₃⁻, trifluoromethylsulfonate (CF₃SO₃⁻), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻); or having the formula

 Cat_1-An_1

or having the formula

Cat₁-Bridge₁-An₁

or having the formula

Cat₁-Bridge₁-An₁-Bridge₂-Cat₂,

40 or having the formula

An₂-Bridge₂-Cat₁-Bridge₁-An₁,

wherein Cat_1 -An $_1$ represents a charge transfer complex;

wherein Cat₁ and Cat₂ independently represent a radical having the structural formula

$$R_{30}$$
 R_{26}
 R_{27}
 R_{31}
 R_{17}
 R_{18}
 R_{28}
 R_{29}
 R_{32}

or having the structural formula

$$R_{17}$$
 R_{30}
 R_{17}
 R_{31}
 R_{31}
 R_{31}
 R_{30}
 R_{30}
 R_{17}
 R_{18}
 R_{17}
 R_{18}
 R_{19}
 R_{19}
 R_{19}
 R_{19}
 R_{19}
 R_{19}

or having the structural formula

$$R_{19} = \begin{bmatrix} E_1 & E_2 & \vdots \\ \vdots & \vdots & \vdots \\ R_{17} & R_{18} & \vdots \end{bmatrix} R_{20}$$

$$R_{26}$$
 R_{27}
 R_{26}
 R_{27}
 R_{28}
 R_{27}
 R_{28}
 R_{27}
 R_{28}
 R_{27}
 R_{28}
 R_{30}
 R_{47}
 R_{18}
 R_{31}

or having the structural formula

wherein R₁₇ and R₁₈ independently of one another denote C₁ to C₁₈ -alkyl, C₂ to C₁₂ alkenyl, C₃ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl or R₁₇ and R₁₈ together
form a -(CH₂)₂-, -(CH₂)₃-, or -CH=CH- bridge, R₁₉, R₂₀ and R₂₂ to R₂₅ independently of
one another denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₄ -alkoxy, halogen, cyano, nitro or

70

75

80

85

C₁ to C₁₈ -alkoxycarbonyl or R₂₂ and R₂₃ and/or R₂₄ and R₂₅ form a -CH=CH-CH=CHbridge; R₂₆, R₂₇, R₂₈ and R₂₉ independently of one another denote hydrogen or, in pairs, a -(CH₂)₂-, -(CH₂)₃- or -CH=CH- bridge, E₃ and E₄ independently of one another denote O, N-CN, C(CN)₂ or N-C₆ - to C₁₀-aryl, R₃₄ and R₃₅ independently denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₁₈ -alkoxy, halogen, cyano, nitro, C₁ to C₁₈ -alkoxycarbonyl or C₆ to C₁₀ aryl, R₃₀ to R₃₃ independently of one another denote hydrogen or C₁ to C₆ -alkyl, or R₃₀ and R₂₆ and/or R₃₁ and R₂₇ form a -CH=CH-CH=CH- bridge, E₁ and E₂ independently of one another denote O, S, NR₃₆ or C(R₃₆)₂ or E₁ and E₂ together form a -N-(CH₂)₂-Nbridge, R₃₆ denotes C₁ to C₁₈ -alkyl, C₂ to C₁₂ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ aralkyl or C_6 to C_{10} -aryl, Z_1 denotes a direct bond, -CH=CH-, -C(CH₃)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N-N=C(CH₃)- or -CCl=N-N=CCl-, Z_2 denotes -(CH₂)_r- or -CH₂-C₆H₄-CH₂-, r=1-10, C⁻ is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), and D⁻ is selected from the group consisting of halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), wherein bonding to the bridge member bridge₁ or bridge₂ is effected via one of the radicals R₁₇-R₃₆, and the radicals mentioned then represent a direct bond,

and wherein An₁ and An₂ independently represent radicals having the structural formula:

or having the structural formula

or having the structural formula

or having the structural formula

95 or having the structural formula

105

110

77

or having the structural formula

or having the structural formula

$$R_{44}$$
 R_{46}
 R_{43}
 R_{45}

or having the structural formula

or having the structural formula

or wherein An₁ or An₂ independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein R₃₇ to R₄₃ independently of one another denote C₁ to C₁₈ - alkyl, C₂ to C₁₂ -alkenyl, C₃ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl, and R₄₁ to R₄₃ additionally denote hydrogen, R₄₄ to R₅₀ independently of one another denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₁₈ -alkoxy, halogen, cyano, nitro, C₁ to C₁₈ - alkoxycarbonyl or C₆ to C₁₀ -aryl and R₄₈ and R₄₉ additionally denote an optionally benzo-

- fused aromatic or quasiaromatic five- or six-membered heterocyclic ring and R₅₀ 115 additionally independently denotes N(R₅₁)(R₅₂), R₄₄ and R₄₅ and/or R₄₆ and R₄₇ form a -(CH₂)₃-, -(CH₂)₄-, -(CH₂)₅- or -CH=CH-CH=CH- bridge, Z₃ denotes a direct bond or a -CH=CH- or -N=N- bridge, =Z₄= denotes a direct double bond or a =CH-CH= or =N-N= bridge, E₃ and E₄ independently of one another denote O, S, NR₅₁, C(R₅₁)(R₅₂), C=O or SO₂, E₅ to E₈ independently of one another denote S, Se or NR₅₁, R₅₁ and R₅₂ 120 independently of one another denote C_1 to C_{12} -alkyl, C_2 to C_8 -alkenyl, C_3 to C_7 cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl, R₅₃ to R₆₀ independently of one another denote hydrogen, C_1 - to C_6 -alkyl, C_1 to C_{18} -alkoxy, cyano, C_1 to C_{18} -alkoxycarbonyl or C₆ to C₁₀ -aryl, or R₅₃ and R₅₄ and R₅₉ and R₆₀ independently of one another together form 125 a -(CH₂)₃-, -(CH₂)₄- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge member Bridge₁ or Bridge₂ is effected by one of the radicals R₃₇ –R₅₄, or R₆₀ and the radicals mentioned then represent a direct bond, and Bridge₁ or Bridge₂ independently represents a bridge member of the formula $-(CH_2)_n$ or $-(Y_1)_s(CH_2)_m$ $-(Y_2)_o$ $-(CH_2)_p$ $-(Y_3)_q$, each of which is optionally substituted by C_1 to C_{18} -alkoxy, halogen or phenyl, Y_1 to Y_3 independently of one another independently represent O, S, NR₆₁, COO, CONH, 130 NHCONH, cyclopentanediyl, cyclohexanediyl, phenylene or naphthylene, betadicarbonyls, R₆₁ denotes C₁ to C₆ -alkyl, C₂ to C₆ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ aralkyl or C_6 - to C_{10} -aryl, n=0-12, m=0-8, p=0-12, o=0-6, q=0-1, and s=0-1.
 - 18. The electrolyte solution of claim 13, wherein said bifunctional redox dye comprises a redox active moiety comprising a pyrazoline, metallocene, phenylenediamine, benzidine, phenoxadine, phenothiazine, tetrafulvalene, phenazine, viologen or anthraquinone, and an energy receptor moiety comprising a benzophenone, benzotraizole, or cyanoacrylate.
 - 19. The electrolyte solution claim 11, further comprising at least one additive selected from the group consisting of non-ionic cosolvents, polymers, thixotropic agents, and UV stabilizers.
 - 20. The electrolyte solution of claim 11, wherein said bifunctional redox dye comprises a compound having the formula

 $[Cat_1][M]$

wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II); wherein Cat₁ represents a ligand having the structural formula

$$R_{30}$$
 R_{26}
 R_{27}
 R_{31}
 R_{17}
 R_{18}
 R_{28}
 R_{29}
 R_{32}

or having the structural formula

or having the structural formula

$$R_{19} = \begin{bmatrix} E_1 & E_2 & \vdots \\ N^+ & C^- & D^- & R_{18} \end{bmatrix}$$

or having the structural formula

$$C^{-}$$
 R_{26}
 R_{27}
 R_{47}
 R_{47}
 R_{49}
 R_{47}
 R_{49}
 R_{47}
 R_{49}
 R_{47}
 R_{49}
 R_{49}

or having the structural formula

15

or having the structural formula

25

30

35

wherein R_{17} and R_{18} independently of one another denote C_1 to C_{18} -alkyl, C_2 to C_{12} -alkenyl, C_3 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl or R_{17} and R_{18} together form a -(CH_2)₂-, -(CH_2)₃-, or -CH=CH-, R_{19} , R_{20} and R_{22} to R_{25} independently of one another denote hydrogen, C_1 to C_{18} -alkyl, C_1 to C_{18} -alkoxy, halogen, cyano, nitro or C_1 to C_{18} -alkoxycarbonyl or R_{22} and R_{23} and/or R_{24} and R_{25} form a -CH=CH-CH=CH- bridge; R_{26} , R_{27} , R_{28} and R_{29} independently of one another denote hydrogen or, in pairs, a -(CH_2)₂-, -(CH_2)₃- or -CH=CH- bridge, E_3 and E_4 independently of one another denote O, N-CN, $C(CN)_2$ or N- C_6 - to C_{10} -aryl, R_{34} and R_{35} independently denote hydrogen, C_1 to C_{18} -alkoxy, halogen, cyano, nitro, C_1 to C_{18} -alkoxycarbonyl or C_6 to C_{10} - aryl, R_{30} to R_{33} independently of one another denote hydrogen or C_1 - C_6 -alkyl, or R_{30} and R_{26} and/or R_{31} and R_{27} form a -CH=CH-CH=CH- bridge, E_1 and E_2 independently of one another denote O, S, NR_{36} or $C(R_{36})_2$ or E_1 and E_2 together form a -N-(CH_2)₂-N- bridge, R_{36} denotes C_1 to C_{18} -alkyl, C_2 to C_{12} -alkenyl, C_4 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl, Z_1 denotes a direct bond, -CH=CH-, - $C(CH_3)=CH$ -,

-C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N-N=C(CH₃)- or -CCl=N-N=CCl-, Z₂ denotes -(CH₂)_r- or -CH₂-C₆H₄-CH₂-, r=1-10, C⁻ is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), and D⁻ is selected from the group consisting of halogen anion, ClO₄⁻, BF₄⁻, PF₆⁻, AsF₆⁻, SbF₆⁻, CH₃COO⁻, and CH₃(C₆H₄)SO₃⁻, trifluoromethylsulfonate (CF₃SO₃⁻), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻).

21. A compound having the structural formula

$$R_{10}$$
)m
 R_{12}
 R_{13}
 R_{13}

or having the structural formula

$$R_{10}$$
 R_{12} R_{14} R_{14} R_{14} R_{14} R_{14} R_{14} R_{15} R_{16} R_{17} R_{18} R_{19} R

5 or having the structural formula

wherein A is selected from the group consisting of trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide 10 ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻); B⁻ is selected from the group consisting of a halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and 15 tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C^{*}); wherein R₁₀ and R₁₁ are each independently a hydrocarbon group selected from the group consisting of an alkyl, alkenyl and aryl group having 1 to 10 carbon atoms, in the case where R₁₀ or R₁₁ is an aryl group, the aryl group forms a condensed ring together with a cyclopentadienyl ring; wherein m=0-4; wherein n=0-4; wherein R₁₂ and R₁₃ are each independently a hydrocarbon residue having 1 to 20 carbon atoms, or alkylene groups having ester-bond unit, ether-bond unit, 20 amide-bond unit, thioether-bond unit, amine-bond unit, urethane-bond unit, or silyl unit in the part of hydrocarbon groups, and R₁₄ is a hydrocarbon group selected from the group consisting of an alkyl, cycloalkyl, alkenyl, aryl, or aralkyl group having 1 to 20 carbon atoms, a heterocyclic group having 4 to 20 carbon atoms, and a substituted hydrocarbon or heterocyclic group obtained by substituting part of hydrogens of the hydrocarbon group or 25 heterocyclic group with a substituent group; and Me represents Cr, Co, Fe, Mn, Ni, Os, Ru, V, Mo(X)(Q), Nb(X)(Q), Ti(X)(Q), V(X)(Q) or Zr(X)(Q) wherein X and Q are each independently selected from the group consisting of hydrogen, halogen, an alkyl group having 1 to 12 carbon atoms, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N), 30 bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻);

or having the formula

Cat₁-An₁

or having the formula

Cat₁-Bridge₁-An₁

or having the formula

Cat₁-Bridge₁-An₁-Bridge₂-Cat₂,

or having the formula

40

45

50

An₂-Bridge₂-Cat₁-Bridge₁-An₁,

wherein Cat₁-An₁ represents a charge transfer complex;

wherein Cat₁ and Cat₂ independently represent a radical having the structural formula

$$R_{30}$$
 R_{26}
 R_{27}
 R_{31}
 R_{17}
 R_{18}
 R_{28}
 R_{29}
 R_{32}

or having the structural formula

$$R_{30}$$
 R_{31}
 R_{31}
 R_{31}
 R_{30}
 R_{30}
 R_{31}
 R_{31}
 R_{31}
 R_{30}
 R_{30}

or having the structural formula

$$R_{19}$$
 R_{19}
 R_{19}

or having the structural formula

$$C^{-}$$
 R_{30}
 R_{17}
 R_{18}
 R_{31}
 R_{31}

or having the structural formula

or having the structural formula

55

60

65

wherein R_{17} and R_{18} independently of one another denote C_1 to C_{18} -alkyl, C_2 to C_{12} -alkenyl, C_3 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl or R_{17} and R_{18} together form a -(CH_2)₂-, -(CH_2)₃-, or -CH=CH- bridge, R_{19} , R_{20} and R_{22} to R_{25} independently of one another denote hydrogen, C_1 to C_{18} -alkyl, C_1 to C_4 -alkoxy, halogen, cyano, nitro or C_1 to C_{18} -alkoxycarbonyl or R_{22} and R_{23} and/or R_{24} and R_{25} form a -CH=CH-CH-bridge; R_{26} , R_{27} , R_{28} and R_{29} independently of one another denote hydrogen or, in pairs, a -(CH_2)₂-, -(CH_2)₃- or -CH=CH- bridge, E_3 and E_4 independently of one another denote O, N-CN, $C(CN)_2$ or N- C_6 - to C_{10} -aryl, R_{34} and R_{35} independently denote hydrogen, C_1 to C_{18} -alkoxy, halogen, cyano, nitro, C_1 to C_{18} -alkoxycarbonyl or C_6 to C_{10} - aryl, R_{30} to R_{33} independently of one another denote hydrogen or C_1 to C_6 -alkyl, or R_{30}

and R₂₆ and/or R₃₁ and R₂₇ form a -CH=CH-CH=CH- bridge, E₁ and E₂ independently of one another denote O, S, NR₃₆ or C(R₃₆)₂ or E₁ and E₂ together form a -N-(CH₂)₂-Nbridge, R₃₆ denotes C₁ to C₁₈ -alkyl, C₂ to C₁₂ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ -70 aralkyl or C₆ to C₁₀ -aryl, Z₁ denotes a direct bond, -CH=CH-, -C(CH₃)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N- $N=C(CH_3)$ - or -CCl=N-N=CCl-, Z_2 denotes $-(CH_2)_r$ - or $-CH_2-C_6H_4-CH_2-$, r=1-10, C^- is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and 75 tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), and D⁻ is selected from the group consisting of halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N⁻), bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), wherein bonding to the bridge 80 member bridge₁ or bridge₂ is effected via one of the radicals R₁₇-R₃₆, and the radicals mentioned then represent a direct bond,

and wherein An₁ and An₂ independently represent radicals having the structural formula:

or having the structural formula

85

or having the structural formula

or having the structural formula

or having the structural formula

95

or having the structural formula

or having the structural formula

$$R_{44}$$
 E_{5}
 E_{6}
 E_{7}
 R_{46}
 R_{47}

100

$$R_{44} = \begin{bmatrix} R_{42} \\ R_{44} \end{bmatrix}$$

$$R_{45}$$

$$R_{46}$$

$$R_{43}$$

or having the structural formula

105

110

115

or wherein An_1 or An_2 independently represent a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II), wherein R_{37} to R_{43} independently of one another denote C_1 to C_{18} - alkyl, C_2 to C_{12} -alkenyl, C_3 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl, and R_{41} to R_{43} additionally denote hydrogen, R_{44} to R_{50} independently of one another denote hydrogen, C_1 to C_{18} -alkoxy, halogen, cyano, nitro, C_1 to C_{18} - alkoxycarbonyl or C_6 to C_{10} -aryl and R_{48} and R_{49} additionally denote an optionally benzofused aromatic or quasiaromatic five- or six-membered heterocyclic ring and R_{50} additionally independently denotes $N(R_{51})(R_{52})$, R_{44} and R_{45} and/or R_{46} and R_{47} form a - $(CH_2)_3$ -, - $(CH_2)_4$ -, - $(CH_2)_5$ - or -CH=CH-CH=CH- bridge, Z_3 denotes a direct bond or a - CH=CH- or -N=N- bridge, = Z_4 = denotes a direct double bond or a =CH-CH= or =N-N= bridge, E_3 and E_4 independently of one another denote O, S, NR_{51} , $C(R_{51})(R_{52})$, C=O or

125

130

5

SO₂, E₅ to E₈ independently of one another denote S, Se or NR₅₁, R₅₁ and R₅₂ independently of one another denote C₁ to C₁₂ -alkyl, C₂ to C₈ -alkenyl, C₃ to C₇ - cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl, R₅₃ to R₆₀ independently of one another denote hydrogen, C₁ - to C₆ -alkyl, C₁ to C₁₈ -alkoxy, cyano, C₁ to C₁₈ -alkoxycarbonyl or C₆ to C₁₀ -aryl, or R₅₃ and R₅₄ and R₅₉ and R₆₀ independently of one another together form a -(CH₂)₃-, -(CH₂)₄- or -CH=CH-CH=CH- bridge, v=0-10, wherein bonding to the bridge member Bridge₁ or Bridge₂ is effected by one of the radicals R₃₇ -R₅₄, or R₆₀ and the radicals mentioned then represent a direct bond, and Bridge₁ or Bridge₂ independently represents a bridge member of the formula -(CH₂)_n- or -(Y₁)_s(CH₂)_m-(Y₂)_o-(CH₂)_p-(Y₃)_q-, each of which is optionally substituted by C₁ to C₁₈ -alkoxy, halogen or phenyl, Y₁ to Y₃ independently of one another independently represent O, S, NR₆₁, COO, CONH, NHCONH, cyclopentanediyl, cyclohexanediyl, phenylene or naphthylene, beta-dicarbonyls, R₆₁ denotes C₁ to C₆ -alkyl, C₂ to C₆ -alkenyl, C₄ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ - to C₁₀ -aryl, n=0-12, m=0-8, p=0-12, o=0-6, q=0-1, and s=0-1.

22. A compound having the structure the formula, wherein said bifunctional redox dye comprises a compound having the formula

$[Cat_1][M]$

wherein M represents a metal salt comprising titanium (III), vanadium (III), vanadium (IV), iron (II), cobalt (II), copper (I), silver (I), indium (I), tin (II), antimony (III), bismuth (III), cerium (III), samarium (II), dysprosium (II), ytterbium (II), or europium (II); wherein Cat₁ represents a ligand having the structural formula

$$R_{17}$$
 R_{17}
 R_{18}
 R_{18}
 R_{28}
 R_{29}
 R_{31}

$$R_{30}$$
 R_{31}
 R_{31}
 R_{30}
 R_{30}
 R_{31}
 R_{31}
 R_{30}
 R_{30}

$$R_{19}$$
 R_{19}
 R_{19}

or having the structural formula

$$R_{28}$$
 R_{27} R_{10} R_{10} R_{10} R_{10} R_{10} R_{11} R_{12} R_{21} R_{21} R_{22}

or having the structural formula

15

or having the structural formula

20 or having the structural formula

wherein R_{17} and R_{18} independently of one another denote C_1 to C_{18} -alkyl, C_2 to C_{12} alkenyl, C₃ to C₇ -cycloalkyl, C₇ to C₁₅ -aralkyl or C₆ to C₁₀ -aryl or R₁₇ and R₁₈ together 25 form a - $(CH_2)_2$ -, - $(CH_2)_3$ -, or -CH=CH-, R_{19} , R_{20} and R_{22} to R_{25} independently of one another denote hydrogen, C₁ to C₁₈ -alkyl, C₁ to C₁₈ -alkoxy, halogen, cyano, nitro or C₁ to C₁₈ -alkoxycarbonyl or R₂₂ and R₂₃ and/or R₂₄ and R₂₅ form a -CH=CH-CH=CH- bridge; R₂₆, R₂₇, R₂₈ and R₂₉ independently of one another denote hydrogen or, in pairs, a -(CH₂)₂-, -(CH₂)₃- or -CH=CH- bridge, E₃ and E₄ independently of one another denote O, 30 N-CN, C(CN)₂ or N-C₆ - to C₁₀-aryl, R₃₄ and R₃₅ independently denote hydrogen, C₁ to C₁₈ -alkyl, C1 to C18 -alkoxy, halogen, cyano, nitro, C1 to C18 -alkoxycarbonyl or C6 to C10 aryl, R₃₀ to R₃₃ independently of one another denote hydrogen or C₁ -C₆ -alkyl, or R₃₀ and R₂₆ and/or R₃₁ and R₂₇ form a -CH=CH-CH=CH- bridge, E₁ and E₂ independently of one another denote O, S, NR₃₆ or C(R₃₆)₂ or E₁ and E₂ together form a -N-(CH₂)₂-N- bridge, 35 R_{36} denotes C_1 to C_{18} -alkyl, C_2 to C_{12} -alkenyl, C_4 to C_7 -cycloalkyl, C_7 to C_{15} -aralkyl or C_6 to C_{10} -aryl, Z_1 denotes a direct bond, -CH=CH-, -C(CH₃)=CH-, -C(CN)=CH-, -CCl=CCl-, -C(OH)=CH-, -CCl=CH-, -C=C-, -CH=N-N=CH-, -C(CH₃)=N- $N=C(CH_3)$ - or -CCl=N-N=CCl-, Z_2 denotes $-(CH_2)_r$ - or $-CH_2-C_6H_4-CH_2-$, r=1-10, C^* is selected from the group consisting of bis(trifluoromethylsulfonyl)imide ((CF₃SO₂)₂N²), 40 bis(perfluoroethylsulfonyl)imide ((CF₃CF₂SO₂)₂N⁻) and tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻), and D⁻ is selected from the group consisting of halogen anion, ClO₄, BF₄, PF₆, AsF₆, SbF₆, CH₃COO, and CH₃(C₆H₄)SO₃, trifluoromethylsulfonate (CF₃SO₃), bis(trifluoromethylsulfonyl)imide $((CF_3SO_2)_2N^2)$, bis(perfluoroethylsulfonyl)imide $((CF_3CF_2SO_2)_2N^2)$ and 45 tris(trifluoromethylsulfonyl)methide ((CF₃SO₂)₃C⁻).

23. A method for filling an empty electrooptic device with fluid comprising warm ionic liquid electrolyte solution, the device having relatively closely spaced plates, each

plate having an inwardly facing conductive surface, the plates being sealed around their periphery by a seal that encloses an area of each plate, comprising:

- (a) introducing a small opening into the seal of an empty device;
- (b) placing the empty device into a chamber along with a container of fluid comprising ionic liquid electrolyte solution;
- (c) evacuating the chamber;
- (d) lowering the empty device into the fluid such that the opening in the seal is located under the surface of the fluid;
- (e) warming at least a portion of the fluid to a temperature of at least 40°C;
- (f) exposing the fluid to a gas pressure greater than the pressure in the empty device to send the warm fluid into the device; and
- (g) sealing the gap in the peripheral seal of the device.